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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/630,970	07/31/2003	David L. O'Meara	071469-0303786	1845
909	7590	04/26/2006	EXAMINER	
PILLSBURY WINTHROP SHAW PITTMAN, LLP			DANG, PHUC T	
P.O. BOX 10500			ART UNIT	
MCLEAN, VA 22102			PAPER NUMBER	
			2818	

DATE MAILED: 04/26/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/630,970

Applicant(s)

O'MEARA ET AL.

Examiner

PHUC T. DANG

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on RCE filed on March 13, 2006.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-26 and 28-44 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-26 and 28-44 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 31 July 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- ☒ Notice of References Cited (PTO-892)
- ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____
- ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____
- ☐ Notice of Informal Patent Application (PTO-152)
- ☐ Other: _____

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DETAILED ACTION

Request for Continued Examination (RCE)

1. Request for Continued Examination (RCE) filed on March 13, 2006 has been acknowledged and considered.

Claims 1-26 and 28-44 are currently pending in the application.

Oath/Declaration

2. The oath/declaration filed on July 31, 2003 is acceptable.

Claim Rejections - 35 USC § 102

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(f) or (g) prior art under 35 U.S.C. 103(a).

3. Claims 1-4 and 6-23 are rejected under 35 U.S.C. 102 (b) as being anticipated by Buchanan et al. (U.S. Patent No. 6,245,616 B1).

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Regarding claim 1, Buchanan et al. discloses an apparatus and a method of forming a semiconductor microstructure comprising:

positioning a substrate (12, Fig. 2A) in a process chamber [col. 3, lines 7-11];

flowing a process gas comprising a nitrogen-containing oxidizing gas in the process chamber; and

forming an oxynitride layer (22, Fig. 2A) on the substrate (12, Fig. 2A), the oxynitride layer being formed in a self-limiting (col. 3, lines 36-39), thermal oxidation process, wherein the partial pressure of the nitrogen-containing oxidizing gas in the process chamber is less than about 10 Torr [col. 3, lines 3-13].

Regarding claims 2-4, Buchanan et al. discloses the range of the thickness of the oxynitride formed in the process [col. 8, lines 12-15].

Regarding claims 6 and 23, Buchanan et al. discloses the partial pressure of the nitrogen-containing oxidizing gas in the process chamber is less than about 5 Torr [col. 6, lines 3-13].

Regarding claim 7, Buchanan et al. discloses wherein the nitrogen-containing oxidizing gas comprises at least one of NO, N₂O, and NH₃ [col. 3, lines 19-22].

Regarding claim 8, Buchanan et al. discloses the process further comprises an oxygen-containing gas [col. 6, lines 5-9].

Regarding claim 9, Buchanan et al. discloses wherein the oxygen-containing gas comprises at least one of O₂, O₃, H₂O, and H₂O₂ [col. 6, lines 5-9].

Regarding claim 10-11, Buchanan et al. discloses the process gas further comprises an inert gas which comprising at least one of Ar, He, Ne, Kr, Xe, N₂ [Abstract].

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Regarding claims 12-13, Buchanan et al. discloses the substrate temperature is between about 500°C and about 1000°C [col. 6, lines 13-15].

Regarding claim 14, Buchanan et al. discloses wherein the substrate comprises Si and the oxynitride layer comprises SiOxNy [col. 2, lines 19-24].

Regarding claims 15-16, Buchanan et al. discloses comprising exposing the oxynitride layer to a plasma nitridation process where the nitridation process utilizes a process gas comprising at least one of N₂, NO, N₂O and NH₃ [col. 6, lines 3-13].

Regarding claim 17, Buchanan et al. discloses a step of further comprising post-annealing the oxynitride layer using a process gas comprising at least one of N₂O and O₂ [col. 6, lines 3-13].

Regarding claim 18, Buchanan et al. discloses wherein the positioning comprises positioning a substrate containing an initial dielectric layer in a process chamber [Abstract].

Regarding claims 19-21, Buchanan et al. discloses wherein the initial dielectric layer which comprises at least one of an oxide (SiO₂) layer, an oxynitride (SiOxNy) layer, and a nitride (SiNx) layer is formed in a self-limiting oxidation process [Fig. 2 A and col. 1, lines 36-39].

Regarding claims 22-23, Buchanan et al. discloses the processing chamber pressure is less than about 50 Torr [col. 6, lines 3-13].

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior

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art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. Claims 24-26 and 28-29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Buchanan et al. in view of Park et al., hereinafter "Park" (U.S. Patent No. 6,825,518 B2).

Regarding claim 24, claim 24 is rejected under the same rationale sets forth to the above claim 1, except for a high-k layer deposited on the oxynitride layer; and an electrode layer on the high-k layer.

Park, however, discloses an apparatus and a method for fabricating a capacitor comprises a high-k layer (5) deposited on the oxynitride layer (4), and an upper electrode layer (6) on the high-k layer (5) [see col. 2, lines 14-15].

It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the teaching the controller that controls the processing system of Buchanan et al. as taught by Park for a purpose of reducing the thickness of the dielectric layer.

Regarding claims 25-26, Buchanan et al. discloses the range of the thickness of the oxynitride formed in the process (col. 8, lines 12-15).

Regarding claims 28-29, Park discloses the high-k layer comprises at least one of HfO_2 , ZrO_2 , Ta_2O_5 , TiO_2 , Al_2O_3 and HfSiO and the electrode layer comprises at least one of W, Al, TaN, TaSiN, HfN, HfYiN, TiN, TiSiN, Re, Ru and SiGe [col. 2, lines 14-15 and col. 4, lines 34-35].

It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the teaching the materials of the high-k layer and the electrode

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layer of Buchanan et al. as taught by Park for a purpose of reducing the thickness of the dielectric layer.

5. Claims 30 is rejected under 35 U.S.C. 103(a) as being unpatentable over Buchanan et al. in view of Subramony et al., hereinafter "Subramony" (U.S. Publication No. US 2003/0138562 A1).

Regarding claim 30, claim 30 is rejected under the same rationale sets forth to the above claim 1, except for a controller that controls the processing system.

Subramony, however, discloses a controller (900, Fig. 5) that controls the processing system [(490, Fig. 5) (paragraph 0046) page 4].

It would have been obvious to one having ordinary skilled in the art at the time the invention was made to modify the teaching the controller that controls the processing system of Buchanan et al. as taught by Subramony for a purpose of improving the semiconductor microstructure.

6. Claims 31-42 are rejected under 35 U.S.C. 103(a) as being unpatentable over Buchanan et al. and Subramony in view of Ikakura et al., hereinafter "Ikakura" (U.S. Patent No. 6,255,230 B1).

Regarding claims 31-33, Ikakura discloses wherein process chamber comprises a batch type process chamber and comprises a single wafer process chamber [col. 9, lines 22-24].

It would have been obvious to one having ordinary skilled in the art at the time the invention was made to modify the above teaching as discussed above of Buchanan et al. and Subramony as taught by Ikakura for a purpose of improving the semiconductor microstructure.

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Regarding claim 34, Buchanan et al. discloses wherein the substrate comprises Si and the oxynitride layer comprises SiOxNy [col. 2, lines 19-24].

Regarding claim 35, Buchanan et al. discloses the partial pressure of the nitrogen-containing oxidizing gas in the process chamber is less than about 5 Torr [col. 8, lines 12-15].

Regarding claim 36, Buchanan et al. discloses wherein the nitrogen-containing oxidizing gas comprises at least one of NO, N₂O, and NH₃ [col. 3, lines 19-22 and col. 6, lines 5-9].

Regarding claim 37, Buchanan et al. discloses the process further comprises an oxygen-containing gas [Abstract].

Regarding claim 38, Buchanan et al. discloses wherein the oxygen-containing gas comprises at least one of O₂, O₃, H₂O and H₂O₂ [col. 3, lines 19-22 and col. 6, lines 5-9].

Regarding claims 39-40, Buchanan et al. discloses wherein the process gas further comprises an inert gas which comprising at least one of Ar, He, Ne, Kr, Xe, N₂ [Abstract].

Regarding claims 41-42, Buchanan et al. discloses the substrate temperature is between about 500 ° and about 1000 °C [col. 6, lines 13-15].

7. Claims 5 and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Buchanan et al. in view of Solayappan et al., hereinafter "Solayappan" (U.S. Patent No. 5,997,642).

Regarding claim 5, Solayappan discloses the substrate diameter can be greater than about 195 nm [col. 9, lines 66-67].

It would have been obvious to one having ordinary skilled in the art at the time the invention was made to modify the teaching of the substrate diameter can be greater than about

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195 nm of Buchanan et al. as taught by Solayappan for a purpose of improving the semiconductor microstructure process.

Regarding claim 22, Solayappan discloses the processing chamber pressure is below atmospheric pressure [col. 15, lines 65-col. 16, lines 1].

It would have been obvious to one having ordinary skilled in the art at the time the invention was made to modify the teaching of the processing chamber pressure is below atmospheric pressure of Buchanan et al. as taught by Solayappan for a purpose of improving the semiconductor microstructure process.

8. Claims 43-44 are rejected under 35 U.S.C. 103(a) as being unpatentable over Buchanan et al. and Subramony in view of Solayappan et al., hereinafter "Solayappan" (U.S. Patent No. 5,997,642).

Regarding claim 43, Solayappan discloses the processing chamber pressure is below atmospheric pressure [col. 15, lines 65-col. 16, lines 11].

It would have been obvious to one having ordinary skilled in the art at the time the invention was made to modify the teaching of the processing chamber pressure is below atmospheric pressure of Buchanan et al. as taught by Solayappan for a purpose of improving the semiconductor microstructure process.

Regarding claim 44, Buchanan et al. discloses the partial pressure of the nitrogen-containing oxidizing gas in the process chamber is less than about 5 Torr (col. 8, lines 12-15).

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Conclusion

9. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Feldman et al. (U.S. Patent No. 5,904,523) discloses Process for device fabrication in which a layer of oxynitride is formed at low temperatures.

10. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Phuc T. Dang whose telephone number is 571-272-1776. The examiner can normally be reached on 8:00 am-5:00 pm.

11. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David C. Nelms can be reached on (571) 272-1787. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9306 for regular communications and Final communications.

12. Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

Phuc T. Dang



Primary Examiner

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